NATURAL RESOURCES CONSERVATION SERVICE

CONSTRUCTION SPECIFICATIONS

FENCE - PERMANENT ELECTRIC HIGH TENSILE

(Ft.)

CODE 382

III. Permanent Electric High Tensile Fence

(Also refer to Fence drawings)

A minimum of one wire in the fence shall be electrified. Only smooth high-tensile wire will be used on electric fences because of safety hazards with other types.

A. Wire Spacing

The number of wires and spacing shall be designed to accomplish the desired result of the fence. **Table 1** suggests wire spacing for different kinds and classes of animals. Two or more electrified fence wires should be used controlling calves or hogs. Four or more strands should be used for goats and sheep and similar animals. When multiple wire systems are used, spacing of wires should be designed to ensure facial shock when animal attempts to place head between wires. Ensure that at least one positive (+) wire is placed about two-thirds the animal's shoulder height.

In instances where ground moisture is high, an all-positive charged fence would normally suffice. If experience shows that the soil on site will dry to the point of not causing a shock to the animal, then a combination of positive (+) and negative (-) wires should be used. Place positive and negative wires a minimum of 6" apart.

Farm border fences and roadside fences must be constructed of at least four wires, with the total height to the top wire at least 42 inches.

Cross fences can be constructed of one or more wires, with the fence height set at two-thirds of the shoulder height, or set at nose height of the grazing animal. Cross fencing with one- and two-wire electric wires may be used for within-farm uses such as streamside fencing and subdividing pastures, but may not be used for property line or roadside fencing.

TABLE 1. Typical Wire Spacing

Wires	Animal Type	Spacing from Ground (Inches)
1	Cattle	28
2	Cattle, Calves ---------- Hogs	18, 30 ---------- 6, 18
3	Cattle, Calves ---------- Cattle, Horses ---------- Hogs	18, 30, 42 ---------- 20, 34, 46 ---------- 6, 12, 18
4	Cattle, Calves ---------- Cattle, Sheep, Goats	12, 22, 32, 42 ---------- 8, 16, 24, 36
5	Cattle, Horses, Sheep, Goats	8, 16, 24, 36, 48
6-8	Deer, Predator Control	6, 12, 18, 26, 36, 46, 56, 68

B. **Type of Wire**

Wire shall be high tensile, Class III galvanized 12.5-gauge wire or aluminized wire with 170,000 psi minimum breaking strength. The 170,000 psi wire is much easier to work with than the 210,000 psi wire. Use galvanized wire if using wood treated with ACQ because of corrosion.

C. **Pull Assemblies**

For high tensile fence, two posts with brace and brace wire shall be spaced at intervals not to exceed 1,320 feet in straight level sections of the fence. Where turns are encountered, additional wire strainers will be installed for proper tension on fence. One- and two-wire cross fences do not require brace assemblies, but wire should be tied off a minimum of every 660 feet.

D. **Line Post Spacing Length and Depth**

Install line wood posts in dips and rises first. Spacing of line posts and stays depends on terrain and number of wires. Maximum spacing is as follows. Fences may have line posts spaced up to 50 feet apart with no stays required. Line posts may be spaced 150 feet apart with stays or light posts at 50-foot spacing between the posts. Do not use stays with single wire fences. In undulating terrain, space posts and stays so that fence height is maintained. Posts in dips shall be constructed so that they will not pull out of the soil. Posts will be anchored or set to sufficient depth to resist pullout.

Wood posts shall be long enough to be set at least 24 inches in the ground. All wood posts will be at least 2 inches higher than the top wire of the fence to prevent splitting when attaching insulators. All posts of other materials shall be at least 1 inch higher than the top wire of the fence.

Steel posts and other line post shall be driven minimum of 18” deep. Use standard “T” or “U” shaped steel posts minimum of 5.5 ft. long. Metal “T” or “U” posts will weigh at least 1.25 lbs per linear foot.

Post spacing in areas shallow to rock may vary based on availability of post sites. To determine desirable post sites, probe with a rock probe. Steel pipe and steel post are recommended to use in cracks between rocks. Use concrete

around post where possible. Rock bits are available in some areas for drilling rock. Use stays to maintain post spacing. Post set in a 5 gallon bucket of concrete, may be used as a line post. Bury the bucket as deep as possible. Use live trees as post where needed. See section F for guidance.

E. **Line Post and Stays**

Use the following for line posts:

1. Australian ironwood (eucalyptus), 1"x1.5", length and width.

2. Fiberglass and polyvinyl-chloride solid round sucker rod of at least 5/8" in diameter.

3. Fiberglass T-posts and stays of at least 1" in cross-section.

For the above posts, attach wire to post by clips or by running cotter keys through holes in post. Cotter keys are preferred. Attach to stays with tight clips to hold in place.

Wood posts of black or honey locust, red cedar heartwood, Osage orange, pressure treated pine, catalpa, mulberry or other wood of equal life and strength will be used. At least one-half of the diameter of the red cedar post shall be heartwood. Pressure treatment shall conform to American Wood-Preservers' Association standard, U1-06, UC4A. Below are some common preservative treatments with minimum retention rates:

Treatment	Retention lb/ft3
Creosote coal tar	10
Pentachlorphenol	.5
Amoniacal copper arsenate	.4
Chromated copper sulfate	.4
Alkaline copper quat (ACQ)*	.4

* Do not use aluminum fasteners or metals wood treated with ACQ. Use hot-dipped, galvanized coated or stainless steel staples or wires.

Wire shall be attached by insulators. See section L. for insulation guidance. Wood line posts shall be at least 3 inches in diameter.

Steel posts may be "T" or "U" posts that are a minimum of 1.25 pounds per one foot of length. Charged wire must be attached with insulators. See L. Insulation for guidance.

F. **Live Trees as Line, Bracing, and Corner Posts**

Live trees used for corner, bracing, and line posts shall have a diameter breast height (DBH) equal to or greater than those prescribed for normal wooden posts. Some alignment variation shall be allowed, but caution should be taken to minimize offsets and prevent excess fencing needs.

Wires or insulators will not be fastened directly to trees. When using live trees, protection will be provided between the tree and wire or insulator (UC3 treated 2" x 4", fiberglass, or rigid plastic strip). Avoid using trees with a short lifespan (i.e., elms and musslewood). Avoid using potentially high-value timber trees.

Do not use fast growing trees as end post.

G. **Corner, End, Brace, and Pull Assemblies**

Braces and end assemblies are required at all corners, gates, and angles up to 150 degrees in the fence line. No brace assembly is required for angles between 150 and 180 degrees; however, use a 5-inch diameter post as a corner post. Lean the corner post 2 inches or more away from the direction of pull.

Electric fences with three or more wires require an H-brace, N-brace, or a floating angle brace assembly at all corner, gate, and end or pull assemblies. Associated posts will be 5-inch nominal wood or 2.5-inch nominal steel pipe (capped). Steel pipe shall be set in concrete at least 30 inches deep. Set or drive posts at least 36 inches deep. Thoroughly tamp earth backfill around set posts. If concrete is used set the posts a minimum of 30 inches deep in a 12-inch wide hole. Posts of equivalent strength may be substituted if they have suitable means of attaching wires and braces.

All wood posts will be at least 2 inches higher than the top wire of the fence to prevent splitting when attaching insulators.

All posts of other materials shall be at least 1 inch higher than the top wire of the fence.

One- and two-wire electric fence corner, gate, and end assemblies may consist of any of the following:

- Wood, steel or fiberglass posts with a minimum top diameter of 5 inches. Without any bracing, set posts 36" in ground. Install end posts with the top leaning approximately 2-5 inches opposite the direction of pull.

- For brace post or pull post assemblies use wooden posts with a minimum top diameter of 5 inches or steel pipe with a nominal diameter of 2.5 inches.

- Wood posts will be set 30 inches in the ground with appropriate knee, floating angle, H-brace, or N-brace.

- Steel pipe or fiberglass posts with a minimum diameter of 2.5 inches, set 30 inches in the ground with appropriate floating angle, H-bracing, knee brace, or N-brace.

- Steel pipe or fiberglass posts with a minimum diameter of 2.5 inches set in 30" of concrete.

H. **Bracing**

The brace member shall be the equivalent of a 4-inch top diameter post or standard weight galvanized steel pipe of 2-inch diameter installed at least 3 feet aboveground or between the top two wires, whichever is higher. Place brace at least 8 inches below

top of post. The brace member shall be a minimum of 6' or 2.5 times the height of the top wire (i.e., 42" x 2.5 = 105" or 8.75').

The brace wire shall be number 9 gauge smooth wires or equivalent. Twist sticks or inline strainers will be used to tighten brace wire.

I. **Staples and Wire Fasteners**

Wires will be attached to line posts by a method that allows wires to slip. If stays are used, wires will be attached to stays in a manner that prevents stay slippage along the fence. Cotter keys are preferred to clips for both post and stays.

If some wires are not electrified, use the following staples. Staples shall be of 9-gauge steel or heavier with a minimum length of 1 ½ inch for close-grained hardwoods. Barbed staples shall be used for softwood posts. To avoid splitting posts and loosening of staples, drive staple diagonally to the wood's grain and at a slight downward angle (upward if pull is up). Space should be left between staple and post to permit free movement of wire. Use hot-dipped galvanized staples for wood treated with ACQ.

Splicing of high tensile wire will be accomplished by three crimping sleeves, "figure eight knots," or "square knots."

Tying of high tensile wire to end posts will be accomplished using "thread through method" or two crimping sleeves. Tension of wires will be designed to maintain the proper average height of the fence wire and tightness to provide wire contact with animals.

The tension on each wire shall be maintained according to type of grazing animal. Use of inline strainers will be used on each wire to obtain the correct tension. Number of inline strainers is dependent on number of turns. Typically, one inline strainer can tension 800-1000' of straight fence. Place inline strainers, staggered between strands of wire, in the middle of a straight span. Tension springs are optional, but are helpful in maintaining proper tension and absorbing sudden shocks to the wire.

J. **Offset Brackets**

Offset brackets made of galvanized high tensile spring wire with insulator of high density polyethylene with ultra-violet stabilizer or porcelain can be attached to standard barbed wire fence or woven wire fence to provide transmission line and/or to protect a standard fence.

Place offset brackets no further than 60 feet apart and attach to wires of standard fence next to posts. Place offset brackets at two-thirds the shoulder height or nose height of the animals to be controlled. The offset wire shall be 6" or more away from other

conductors due to induction of electricity.

K. **Energizers**

Electronic energizers or power fence controllers shall be installed according to the manufacturer's recommendations that meet the following minimum specifications:

- High power, low impedance system with solid state circuitry capable of at least 4,000 volt peak output and a short pulse that is less than 300 amps in intensity, finished within .0003 of a second and a rate of 35-65 pulses per minute.

- High impact weather resistant cases.

- 110 volt, 220 volt, 12 volt battery powered capable of operating three weeks without recharging. If the length of fence requires an energizer of more than 4 joules, a solar charger will be needed on the battery systems.

Size – As a rule of thumb, the energizer should be capable of producing one joule of energy for each mile of planned fence when average energy loss to the system is expected. Each joule will typically provide enough power to fence 25 to 40 acres of pastureland.

1. **Ground**

All electric fences must be properly grounded. The energizer ground wire should be connected to a galvanized pipe or rod 1/2 inch or larger in diameter. Bury 3 feet of ground rod for each joule of energy output with a minimum of 6 feet required. Ground rods should be buried where soil remains moist for best results. Drive sufficient 6' to 8' rods into the ground at least 10' apart to provide the required amount of ground rod. Drive at an angle if soil depth is restrictive. Connect a continuous ground wire from the energizer to each rod or pipe with a galvanized steel or aluminum clamp. Copper rods with copper wire may be used if the energizer terminals are stainless steel or copper. If energizer terminals are not stainless steel or copper, do not use copper ground rods due to corrosion at the connection and subsequent loss of electrical continuity. Use copper clamps with copper wire and copper rods.

The ground wire(s) of the fence may be connected to the same ground as the energizer or separate ground with the same size and depth requirement.

More ground rods may be needed for system to function properly. Refer to manufacturer recommendations.

Do not use the grounding system for other existing

applications, such as power poles, breaker boxes, and milk barns. Separate the fence grounding system from any other grounding system by at least 25'.

2. **Lightning Protection**

Lightning can cause damage to the energizer. Most energizers are poorly protected from lightning strike. Install external lightning arrestors for added protection. Place lightning arrestor grounding rods at least 65 feet from those of the energizer.

Install an additional set of ground rods and attach to a lightning arrestor. Use at least one more ground rod on the arrestor than was used on the energizer. Attach the lightning arrestor to the wires of the fence. Install a lightning choke in the fence line immediately between the lightning arrestor and the energizer. The lightning arrestor ground must be better than the energizer ground for it to function properly, because lightning will seek the least resistant route to ground. A spark gap may be used in lieu of a lightning arrestor. A spark gap is a small gap between a hot wire and a ground wire. Set the gap slightly beyond the point that electricity normally sparks.

3. **Surge or Spike Protector**

For protection of 120- or 240-volt energizers install a surge protector between the energizer and power supply.

L. **Insulation**

Insulation used for positively charged wire(s) must be high-density polyethylene with ultraviolet stabilizer or high-density polypropylene with ultraviolet stabilizer.

All underground wire(s) installations must be double insulated, molded, aluminum or high tensile strength steel 14 gauge or larger wire. Use the same size wire as the fence. The insulation must be high-density polyethylene with ultraviolet stabilizer or high-density polypropylene with ultraviolet stabilizer.

Insulators for steel and other conductive material posts must be high-density polyethylene with ultra-violet stabilizer, high-density polypropylene with ultra-violet stabilizer, or porcelain that withstands 10,000 volts.

Insulators for end, corner, and angle braces must be high-density polyethylenes with ultraviolet stabilizer, high-density polypropylene with ultraviolet stabilizer or porcelain that withstands 10,000 volts.

M. **Insulated Wire**

To cross gates and areas where electrical shocks to humans and

livestock should be prevented (e.g., working facilities, watering facilities), use insulated galvanized wire. For underground burial, use wire designed for burial. Placing buried wire inside plastic pipe helps to decrease the incidence of short-circuiting. Install so water does not stand in the conduit pipe. When overhead transmission is used, height should be sufficient for movement of livestock and/or equipment. Do not use insulated copper wire due to corrosion at the splice and lack of tensile strength.

N. **Gates**

Electrified gates may be constructed of a single straight wire, galvanized cable, or polytape with a spring-loaded insulated handle, or an expandable, coiled, high tensile, 12 1/2-gauge wire attached to an insulated handle.

The number of wires shall be determined by the fence objective. Overhead or underground transmission lines will be used to carry electricity past the gate to the remainder of the fence.

O. **Floodgates**

An electrified floodgate may be used instead of a non-electrified floodgate. The electrified floodgate is constructed by stretching an electrified wire across the drainage above high water flow level. Attach droppers of 12 1/2 gauge high tensile fence wire, galvanized cable, galvanized chains, or equivalent to the electrified wire at a spacing of 6 inches. Droppers should extend to within 10 inches above the average normal water level or to the normal recommended fence height above the stream bottom. Connect the floodgate to the electric fence with double insulated cable through a cut-off switch and floodgate controller. If flooding is expected to last some time, switch the floodgate off.